



Case Report

Gastric mucosal tears and wall micro perforations after cardiopulmonary resuscitation in a drowning case

Ugo Da Broi MD (Research Associate)^{a,*},
Carlo Moreschi MD (Professor of Forensic Medicine)^a,
Marta Castellani MD (Research Associate)^a,
Bonetti Antonella MD (Research Associate)^b

^a Department of Medical Morphological Research, Section of Forensic Medicine, University of Udine, Italy
^b Department of Medical Morphological Research, Section of Histology, University of Udine, Italy

Received 1 August 2007; received in revised form 10 March 2008; accepted 18 May 2008

Available online 9 August 2008

Abstract

A fifty year-old woman died after drowning in a swimming-pool. Rescue and ambulance paramedic teams started resuscitation attempts followed by a medical care helicopter team. Acute haematemesis, mucosal tears and gastric micro perforations occurred, due to the cardiorespiratory resuscitation manoeuvres. Death occurred seven days later due to the cerebral anoxia and multiorgan failure.

Forensic investigations excluded possible malpractice during external cardiac massage as responsible for the woman's death, while Judicial Authority considered the death as the consequence of the delayed intervention of the swimming-pool rescue team.

© 2008 Elsevier Ltd and Faculty of Forensic and Legal Medicine. All rights reserved.

Keywords: Drowning; Resuscitation; Gastric Lesions

1. Introduction

Gastric wall lesions or rupture are rare complications following cardiopulmonary resuscitation when ventilatory and external cardiac life supports are applied to patients after a cardiac arrest. During advanced drowning phases, an insufficient control of upper airways impairment causes inhalation and swallowing of large amounts of water.

Rapid oesophagus and stomach flooding occurs with notable increase of gastric volume and pressures.^{1–4}

Initial emergency external cardiac massage procedures in drowning subjects could also increase gastric pressure, causing gastric lesions or ruptures.^{5–9}

We report a case of gastric mucosal tears and wall micro perforations due to cardiopulmonary resuscitation in a woman after drowning in a swimming pool and examine medico-legal implications.

2. Case report

A drowning emergency occurred in a swimming-pool. A rescue team of the swimming-pool recuperated a fifty year old victim from the water and started resuscitation attempts, followed by the intervention of an ambulance paramedic emergency team. Upon the arrival of a helicopter medical care team, the patient underwent tracheal intubation, defibrillation and adrenaline injections.

A stable hemodynamic condition was restored but a postanoxic coma with bilateral mydriasis occurred (Glasgow Coma Scale 3).

During tracheal intubation procedures at the scene, a moderate and inexplicable amount of blood was found in the proximal area of the oesophagus and pharynx.

* Corresponding author. Present address: Sezione Dipartimentale di Medicina Legale, Università degli Studi di Udine, Caserma Reginato, Via Pracchiuso, 14/b, 33100 Udine, Italy. Tel.: +39 0432 506046; fax: +39 0432 504649.

E-mail address: ugo.dabro@spin.it (U. Da Broi).

After ICU hospital admission, an acute haematemesis occurred, requiring endoscopic evaluation and blood transfusion. Endoscopy revealed a large amount of water in the gastric cavity and multiple bleeding mucosal tears (5–8 cm length, 1–2 cm wide, 3–4 mm depth) at the gastric body wall with radial orientation from the cardias and reticular design as well as widespread mucosal petechiae, while no alimentary gastric content was found in the stomach and air passages (trachea, bronchial ways). The abdominal CT scan showed abnormal gastric spreading with mixed water-gas content and showed presence of microbubbles out of the gastric wall and under the diaphragm.

The images were considered as related to gastric wall micro perforations due to cardiorespiratory resuscitation.

A thoracic CT scan revealed oedema images ARDS related at the dependent pulmonary districts, while neuroimaging showed brain oedema with diffuse cortex and brainstem hypodensity signs.

A clinical neurological examination confirmed a persistent postanoxic coma and bilateral dilated pupils (Glasgow Coma Score 3/15). Neurophysiological testing (electroencephalography and somatosensory-evoked potentials) confirmed a serious brainstem and cortex postanoxic functional impairment. The patient underwent medical therapy for gastric lesions, mechanical ventilation and inotropic drug therapy for six days, but clinical worsening occurred, due to a progressive multi organ failure syndrome.

Death occurred seven days after ICU admission, due to multiorgan failure and brain anoxia.

Autopsy confirmed diffuse oedema and postanoxic ischemic brain lesions, pulmonary ARDS lesions and typical heart, liver, splenic, pancreas, renal and surrenal ischemic multiorgan failure syndrome lesions. At autopsy, gastric wall examination confirmed diffuse multiple mucosal tears arising from the cardias area to the gastric body (5–8 cm length, 1–2 cm wide, 3–4 mm depth) and diffuse mucosal petechiae, but there were no macroscopic perforations. Mucosal tears did not lead to the external gastric surface where other diffuse mucosal petechiae were found.

Microscope examination of mucosal tears revealed mucosa, tonaca propria, muscolaris mucosae, submucosa and sierosa large dissection areas, while micro dissections involved the muscular coat. The cause of death was assessed as postanoxic brain damage, multiorgan failure syndrome and cardiac failure following drowning.

3. Discussion

We report on a drowning case in which gastric mucosal tears and transmural micro perforations were diagnosed after cardiorespiratory resuscitation. Rescue operators and an ambulance paramedic team started cardiorespiratory support procedures while a medical care helicopter team continued resuscitation and transported the patient to hospital. Acute haematemesis and gastric wall micro perforations occurred, due to cardiorespiratory resuscita-

tion. Death occurred seven days later, due to postanoxic coma and multiorgan failure syndrome.

Post-mortem examination diagnosed gastric mucosal tears from the cardias area to the gastric body, not involving the wall at the external surface, while microscope examination showed large dissections areas involving mucosa, tonaca propria, muscolaris mucosae, submucosa and sierosa, and micro dissections at muscular coat.

Gastric mucosal tears in drowning deaths without cardiopulmonary resuscitation were described by Blanco Pampin et al. as 2 or 3 mm depth lesions, involving muscularis mucosae, with typical submucosa pinpoint haemorrhages, in absence of total rupture of gastric wall.^{10–12}

The generating mechanism of the above lesions is due to swallowing and stomach flooding of large amounts of water and the process of vomiting (caused by diaphragm and abdominal musculature ejection force), causing tears of the mucosa—also referred to as Sehrt tears.^{10–12}

The gastric lesions we report, were different from those described by Blanco Pampin et al. in subjects after drowning without reanimation, because they showed different sizes (longer, larger, deeper) and caused early clinical signs as serious bleeding and subphrenic air bubbles. The presence of the micro perforations we describe, suggests that the forces which injured the stomach, were not only those described by Blanco Pampin et al., which cause lesions not involving entirely the thickness of the gastric wall.^{10–12}

The forces applied during the external cardiac massage and the forces described by Blanco Pampin et al. could have caused the lesions we describe, producing a combined effect.

Rabl et al. reported that in a viscoelastic water filling model the gastric ruptures may occur around the cardias area and along the lesser curvature of the stomach, which are places of least resistance owing to only one muscular layer and a low number of mucosal folds.¹²

According to different Authors, the lesions reported by Rabl et al. have the same location we describe: after external cardiac massage for events different from drowning, the gastric injuries may locate at the cardias and lesser curve of the stomach too.^{2–12}

The location of the lesions we describe suggests also a combined effect by gastric water filling and external cardiac massage forces.

The timing of swimming-pool rescue team operations, the technical correctness of external cardiac massage and face mask ventilation performed by doctors and paramedics, were investigated by forensic doctors. The use of excessive power and pressure during the application of external cardiac massage and an incorrect face mask ventilation (causing an excessive intake of oxygen/air mixture added to water inside the stomach) by rescue swimming-pool operators and ambulance paramedic team was considered as related to the gastric mucosal tears and wall micro perforations but not responsible for the death of the woman.

The stomach, overfilled by water during drowning and air during face mask ventilation, underwent mucosal tears and wall lesions because of the increase of internal pressure

during the external cardiac massage applied with excessive power and pressure.

No responsibilities involving the helicopter medical care team for gastric injuries or death were considered: helicopter medical operators did not apply external cardiac massage but only early defibrillation, tracheal intubation and inotropic drug infusion.

A delayed intervention of the swimming-pool rescue team was considered as responsible for the death of the woman who wasn't recuperated from the water immediately but some minutes after the immersion (police estimated that the interval time between immersion and starting of resuscitation attempts was 3–4 min).

In conclusion, we observe that:

- (1) Autopsy findings in drowning patients who underwent resuscitation procedures, may support the forensic diagnosis discovering gastric Sehrt tears but also gastric mucosal tears and wall micro perforations like those in the case we reported.
- (2) Resuscitation procedures using excessive power and pressure during external cardiac massage with incorrect face mask ventilation, causing gastric lesions in drowning patients, could open claims for medical malpractice suits.

Conflict of interest

None declared.

References

1. Golden FS, Tipton MJ, Scott RC. Immersion, near-drowning and drowning. *Br J Anaesth* 1997;79:214–25.
2. Moon RE, Long RJ. Drowning and near drowning. *Emergen Med* 2002;14(4):377–86.
3. Ibsen LM, Kock T. Submersion and asphyxial injury. *Crit Care Med* 2002;30(11):S402–8.
4. Lunetta P, Pentilia A, Sajantila A. Circumstances and macropathologic findings in 1590 consecutive cases of bodies found in water. *Am J Foren Med Pathol* 2002;23(4):371–6.
5. Liu N, Boyle K, Bertrand C, Bonnet F. Stomach rupture during CPR. *Ann Emerg Med* 1996;27(1):105–6.
6. Reiger J, Eritscher C, Laubreiter K, Trattnig J, Sterz F, Grimm G. Gastric rupture an uncommon complication after successful cardiopulmonary resuscitation: report of two cases. *Resuscitation* 1997;35(2):175–8.
7. Custer JR, Polley TZ, Moler F. Gastric perforation following cardiopulmonary resuscitation in a child: report of a case and review of the literature. *Pediatr Emerg Care* 1987;381:24–7.
8. Strear CM, Jarnagin WR, Schechter W, Mackersie RC, Hickey MS. Gastric rupture and tension pneumoperitoneum complicating cardiopulmonary resuscitation: case report. *J Trauma* 1998;44(5):930–2.
9. Krause S, Donen N. Gastric rupture during cardiopulmonary resuscitation. *Can Anaesth Soc J* 1984;31(3Pt):319–22.
10. Blanco Pampin J, Garcia Rivero SA, Tamayo NM, Hinojal Fonseca R. Gastric mucosa lesions in drowning: its usefulness in forensic pathology. *Leg Med* 2005;7(2):89–95.
11. Wirth I, Strauch H, Schmeling A. Gastric death as first described by Sehrt (Sehrt's Magentod): a review of the literature. *Arch Kriminol* 2006;217(3–4):92–100.
12. Rabl W, Ennemoser O, Tributsch W, Ambach E. Iatrogenic ruptures of the stomach after balloon tamponade. Two case reports: a viscoelastic model. *Am J Foren Med Pathol* 1995;16(2):135–9.